JANUARY 4, 1961

GAS IN INDUSTRY

Supplement to the "GAS JOURNAL"

Vol. 4 No. 32

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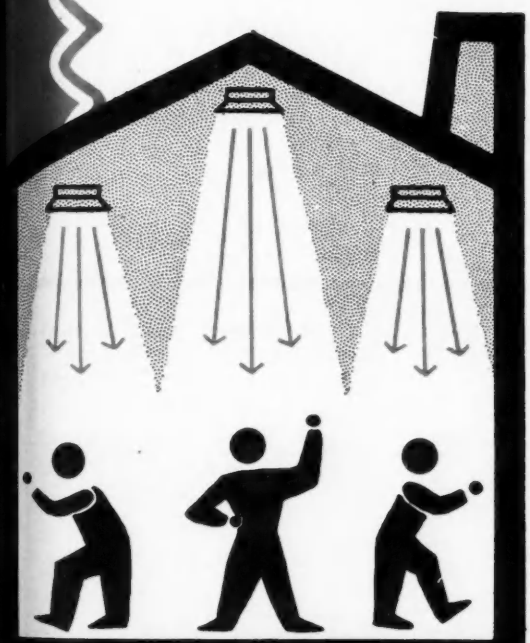

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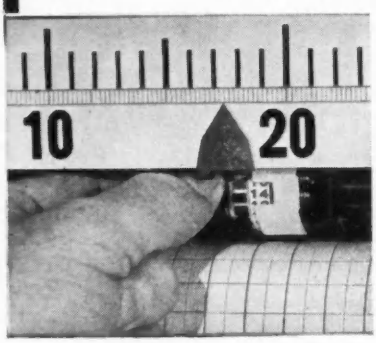

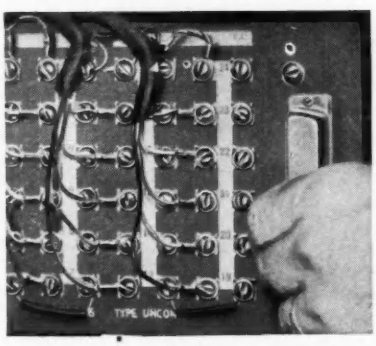

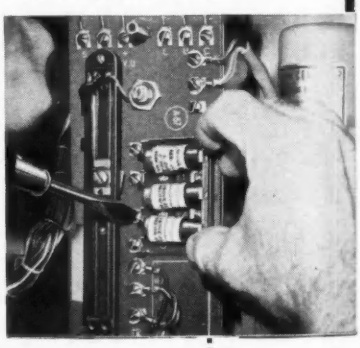

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GAS IN INDUSTRY

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Vol. 4 No. 32

FEATURES

BRITANNIA'S RULE—
BUY GAS
By Eric Ford

AUTOMATIC FINISHING PLANT FOR MOTOR PARTS FACTORY

DEVELOPMENT OF INDUSTRIAL GAS SALES IN N. WALES
By J. A. W. Stretton

GAS KEEPS THEM FLYING
By K. G. Eccleshare and C. H. Hirst

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Editorial

Background to development

THERE are few fields of modern technical development in which gas does not play some vital part. An outstanding example of this participation in actual development work is the field of aviation, a branch of engineering in which the emphasis is constantly on research. In the aircraft industry extensive use is made of gas not only in production processes but in development work, and here the technical service which backs the sale of gas as a fuel for industry has a particular value.

A significant part of the aircraft and allied industries is centred in the vicinity of Bristol, where it accounts for 10% of the South Western Gas Board's total sales of gas to industry.

In this issue we publish part of a paper presented jointly by Mr. K. G. Eccleshare and Mr. C. H. Hirst, which describes some of the development projects with which the Board has been associated in this field. It will be seen that they are of widely varying types, and the fact which shines through the whole account is that in all this work the Gas Board's part is not one of fuel supplier only, but of a partner in development and, not infrequently, the instigator of new techniques.

The point we would like to stress is the technical advisory organisation which functions behind the industrial gas service in the South West, as in other parts of the country. In Bristol the service hinges on the Senior Industrial Engineer and the four industrial engineers under his control, but also resident in Bristol is the Area Industrial Engineer who is consulted and advises on industrial gas affairs throughout the entire area.

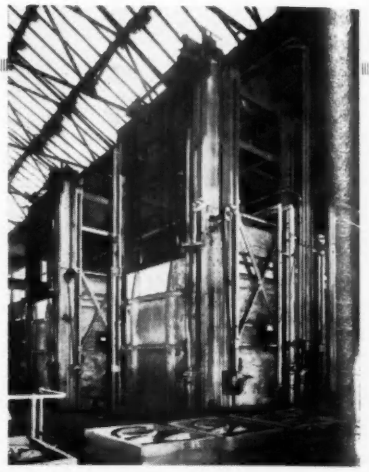
This relatively new extension of the Board's service to industrialists has effected considerable improvement in plant performance.

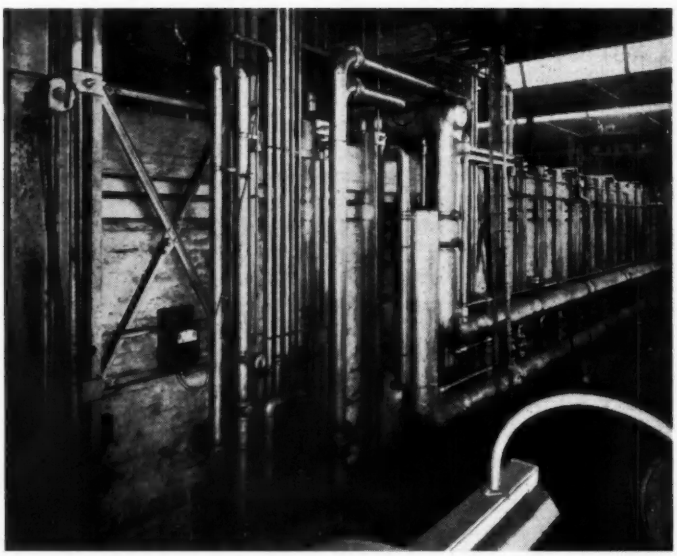
A much welcomed augmentation of the sales policy has been the new industrial showroom in Bristol. Here the Board has available for working demonstrations a small but general range of standard equipment, and in the attached workshop it is possible to assemble special or prototype burner equipment. These facilities have already amply proved their need and it is expected that they will be extended so as to accommodate the design and construction of larger and more complicated non-standard equipment to match the needs of industry.

It is not always appreciated that the industrial gas engineer's first interest is the operation of his customers' equipment in the most efficient *and most economical* manner. He knows that by improving efficiency, even though it reduces gas consumption, the reputation of gas as a fuel will be strengthened. As the authors point out: 'It is not always easy to persuade someone used to the conventional idea of a furnace that it may be possible to do away with the mass of brickwork and get better results by other methods, and instances are known where even demonstration has not carried conviction. Too often standard oven furnaces are being used for work other than that for which the furnace was designed, but because the results required can be achieved no thought is given to alternative methods.'

To show that the Gas Board is anxious to prevent this happening is one of the purposes of the paper, and we feel sure that the examples quoted by the authors emphasise the Board's constant alertness to new developments and their willingness to make the first approach with a new technique.

BRITANNIA'S RULE— BUY GAS





In this view of one of the continuous annealing furnaces, the burner arrangement can be seen. The burners, each with its individual mixer, are sited between the gas and air lines. Both gas and air are pre-heated.

This impressive view of the exit ends of two annealing furnaces illustrates the excellent natural lighting and ample working space which are features of the Britannia Iron & Steel Works Ltd., Bedford.

Bedford company maintains fine work tradition

ERIC FORD tells how world-famous malleable iron tube fittings are made with the help of gas.

EVERYONE connected with gas will be familiar with the **GF** malleable iron tube fitting, which is undoubtedly one of the most widely-used components throughout the gas supply industry.

Originally manufactured in Switzerland by the firm of George Fischer Ltd., these fittings have for over half a century been marketed in this country and throughout the Commonwealth by the Le Bas Tube Co. Ltd., London.

Any fittings derived from this source will be marked with a cross on either side of the trade-mark, thus + **GF**+.

Since 1933, however, **GF** fittings have been manufactured by the Britannia Iron and Steel Works Ltd. at their large Bedford plant, where millions of standard fittings and special castings are produced annually, of which nearly a quarter are exported.

It is perhaps particularly appropriate that fittings which are so widely used in the gas industry and which, in fact, largely owe their inception to the industry, should make big demands on gas for their manufacture.

The Britannia Iron and Steel Works Ltd. consume upwards of 120 mill. cu.ft. of town gas annually in a wide variety of applications.

The supply and service for this considerable load are provided by the Bedford District, Cambridge Division, Eastern Gas Board.

Heat is required at many points in the manufacture of the castings, including such important processes as core drying, foundry work, annealing, heating galvanising baths and casting rectification.

Its selection as a suitable fuel is due

to the consistency and flexibility of control of gas, these factors being particularly important for the precision work necessary when producing fittings of the exceptional quality demanded of those bearing the GF trade mark.

A trade mark of this design (i.e. without the cross on either side) indicates a casting made at Bedford; these are also marketed, as already noted, through the Le Bas Tube Company Ltd.

Those who have delved into the history of gas supply will know that fittings were originally made from wrought iron, frequently roughly fabricated on the spot.

Later, cast iron fittings were made which, however, though cheaper and available in greater variety than the wrought iron type, were heavy and brittle and were therefore not entirely suitable for the gas industry.

Over the past 50 years, however, the GF organisation has developed a method of casting and subsequent heat treatment which produces a casting sufficiently ductile to withstand both the usual strains and stresses of installation and the internal pressures to which they are subjected in service.

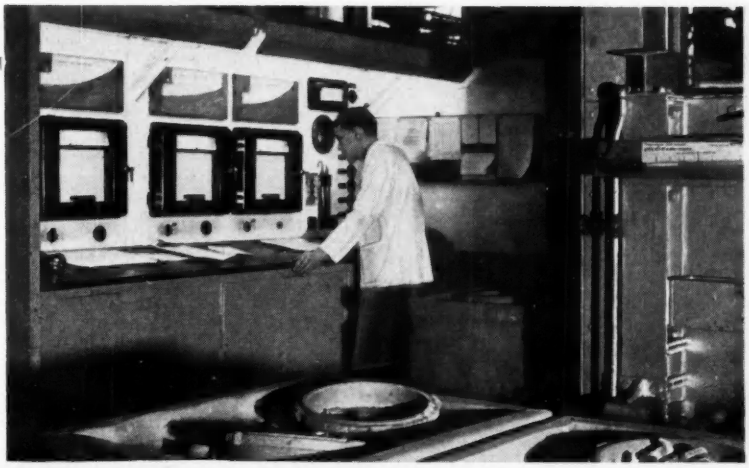
Pig iron, steel scrap and foundry returns and scrap are the primary raw materials from which these castings are made and the Company's scrap yard itself makes an interesting study, containing as it does a remarkable collection of metal scrap from every industry.

The larger items are cut up into suitable sizes by oxy/acetylene cutting equipment and other methods.

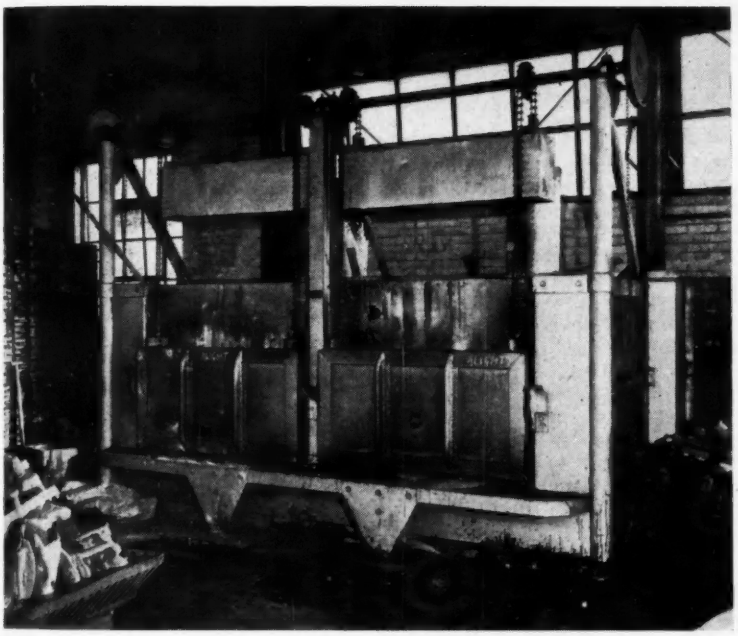
All the scrap used must be of a certain specification and the pig iron must also reach the high standard specified by the Company. Limestone is used as a flux.

Every use is made of mechanical handling methods to deal with the large quantity of raw materials needed for the foundry.

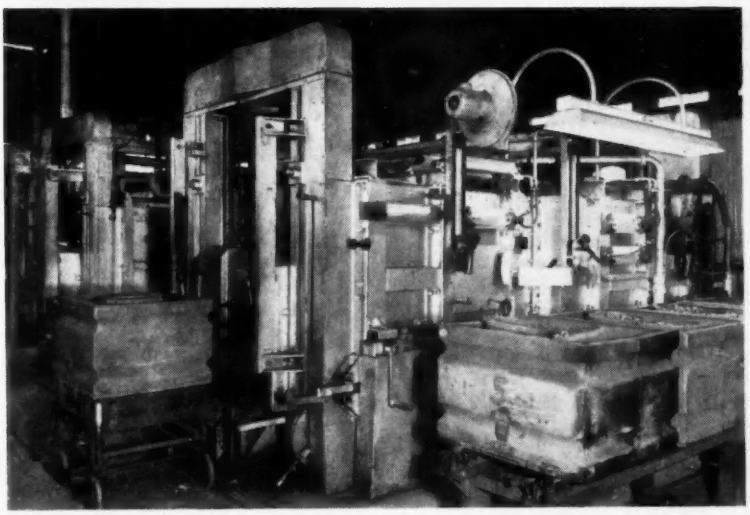
Before considering the opera-



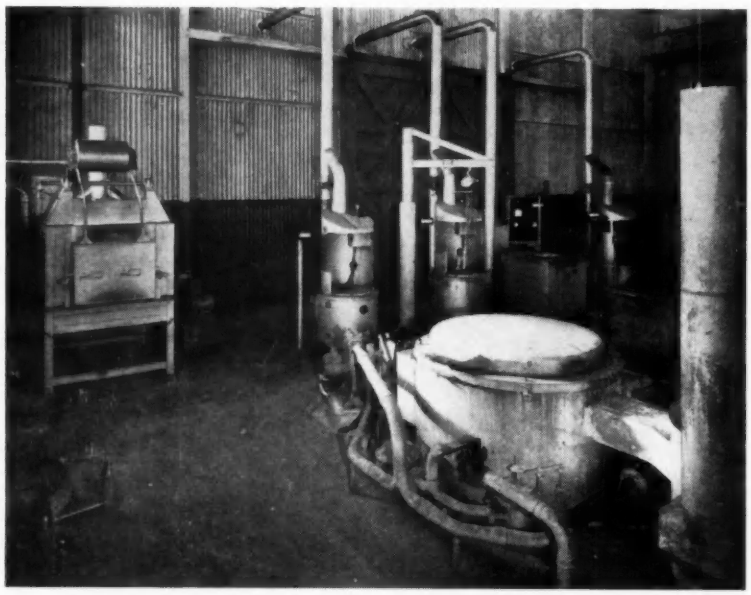
Every convenience for the operator. The neatly-designed control desk of the annealing furnace contains every facility for maintaining the supervision over the furnace.



Two gas-fired furnaces used for stress relieving.



A bank of heat treatment furnaces at the Britannia Iron & Steel Works Ltd.



A selection of gas-fired equipment at the Britannia Iron & Steel Works Ltd., where gas is also used for such purposes as hardening the taps used in finishing operations on some of the fittings. Note the neat layout and clean appearance of this shop.

tions in that department, it is necessary to refer briefly to the work of the pattern shop which, in a sense, is the first stage of the manufacturing process.

In a works of this kind, where the utmost precision in manufacture is demanded, a great deal depends on the work of the pattern shop.

The very high standard of work here ensures that patterns are produced to the finest possible tolerances.

Gas finds a number of important applications here, including a small Morgan Crucible melting furnace and some gas soldering irons.

Core shop

First major applications of gas are seen in the core shop where the specially selected sand is dried and the cores made and baked.

Cores are either made on core blowing machines, in the case of smaller items, or hand-made in larger sizes.

Assembly line methods are used wherever possible, particularly for transferring the cores to and from the drying oven.

This oven, which is gas-fired, is 44 ft. long, 8 ft. wide and 6 ft. high. It is of the forced circulation type with a multi-hole non-aerated burner firing into a separate chamber to produce a long flame.

The burner has a maximum gas consumption of 3,000 cu.ft. per hour and a fan fitted to the outlet end of the oven induces secondary air and also circulates the products of combustion.

Process time, through the oven is approximately 65 minutes and operating temperatures are around 330°C.

This oven has been found to provide a good solution to the important core-drying problem.

Sand drying

Moulding sand, after drying in a rotary sand dryer of conventional design, is passed to the moulding machines which are of the jolt-squeeze type.

The foundry at the Britannia works impresses the visitor by its unusually neat appearance. This is partly due to the construction of the foundry building itself, but more particularly to the layout of the equipment and the 'good housekeeping' policies adopted by the management and foundry staff.

The three cupolas are sited on one side of the foundry and are charged from a platform at first storey height to which the charges of scrap, pig iron, limestone and coke are supplied from outside.

The scrap yard already mentioned is adjacent to this section of the works. Loading of the cupolas is continuous and the contents of each batch are carefully weighed.

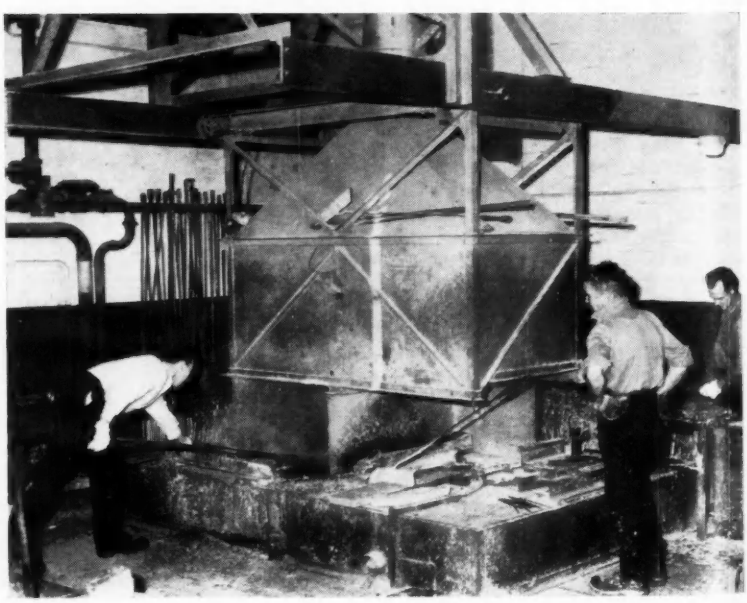
In rotation

One cupola is used at a time, the three being used in strict rotation. Diameters vary from 30 to 36 in., depending on the thickness of the refractory being used. Throughputs of the order of 7-8 tons are obtained over a daily period from 7 a.m. to 4 p.m.

A feature of these cupolas is that they are of the 'hot-blast' type, in which the air is pre-heated before it enters the tuyeres. Hot-blast cupolas of this type are not widely employed in foundry practice and it is interesting to learn that the melting rates obtained are approximately 30% greater than with the normal cold blast while coke consumption is stated to be about 12% by weight of total metal charged.

In addition to the increased melting

About 50% of **GF** *fittings are galvanised. The galvanising bath is gas-fired.*



rate and economy in coke consumption, other advantages include closer control of metal composition, reduced oxidation losses and lower sulphur pick-up.

There are several interesting applications of gas in the foundry area, including the heating up of the cupola receiver and ignition on the coke bed.

The equipment used for this purpose consists of air-blast burners fitted to flexible hose connections.

A further use of gas is for pre-heating the metal carriers and ladles used to handle the melted metal.

To perform this duty, a number of air-blast burners with fish-tail nozzles have been fitted to the foundry wall adjacent to the cupolas.

When a metal carrier is required for service, it is placed in front of a burner and tilted through 90° so that the burner fires directly into it.

Pre-heating of the pouring ladles is effected by means of a table carrying 12 air-blast burners. The burners, three to each mixer, fire vertically through individual supports upon which the ladles are inverted.

Handling

A feature of the foundry is the intelligent use which is made of mechanical handling devices to reduce the amount of physical labour normally associated with foundries and to ensure the most efficient production techniques.

An overall runway system had been installed which not only permits the rapid handling of the one-ton capacity metal carriers, but has also been connected to the adjacent core shop to transport the cores through the core drying oven already described and out again into the storage bay in the foundry.

After tapping from the cupola, into the pre-heated metal carrier, the molten metal is transported on the overhead runway to the moulding boxes for pouring into pre-heated ladles, after which the moulds are cast.

For re-use

The moulding boxes are removed and the sand returned to the Sand Handling Department for re-use.

The castings are separated from the runners which are re-melted. The castings are cleaned in wheelabrators and ingenious shot-blasting machines.

The fittings then undergo the first of several stringent inspections to which they are subjected before leaving the factory, and these inspections, which are particularly thoroughly carried out, play no small part in maintaining the high reputation which all **GF** castings deservedly possess.

Following this inspection, the castings next pass to the annealing department in which gas plays a particularly notable role in firing the impressive Gibbons continuous annealing furnaces.

Castings for annealing are placed in large heat-resistant steel pots and packed round with hematite ore which is shaken well down around the castings to maintain complete contact between the ore and every part of each casting.

The metal pots, packed with castings, are then placed on fire-brick based trucks, each of which will hold six pots, stacked in two layers.

Each individual pot has been previously sealed. The trucks are fitted with flanged wheels which run on rails.

Pushed-in

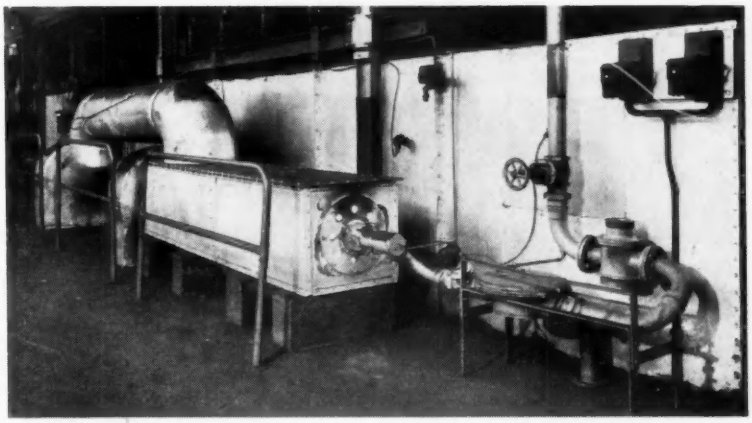
Loaded trucks are lined up on these rails which run parallel to the furnace, the truck nearest to the entry point of the furnace being moved into position directly in front of the furnace door.

When it is time for a fresh truck to be charged, the furnace door is opened, by drawing upwards, and the truck, still on rails, is pushed into the furnace.

The rails run right through the furnace so that as the ram pushes a new truck into it, those already inside are pushed forward and the end truck emerges from the furnace at the exit point.

A fresh truck enters the furnace approximately every nine-and-a-half hours, and the total time between entering and leaving is about ten days.

During this period, the castings pass through a pre-heat zone which raises the temperature up to 980°C. which is maintained in the soaking zone.



General view of the gas-fired core drying oven at the Britannia Iron & Steel Works Ltd., Bedford.

Soaking time is normally about 90 hours. The final cooling zone brings the temperature down gradually to about 550°C.

Firing of this furnace is by 64 air-blast burners, 32 on each side of the furnace which is 105 ft. long and has outside dimensions of 10 ft. wide and 9 ft. high.

Parallel lines

The burners are fed by gas and air lines running parallel to one another and to the floor along each side of the furnace, the gas supply being in the upper of the two pipes.

Each burner has its individual mixer and an interesting feature of the furnace is that both gas and air are pre-heated.

Water tubes are fitted to the cooling zone, the heated water being drawn off and used for space heating.

Thermocouples are fitted at appropriate points in the three zones of the furnace in order that a close check may be kept on the temperature of the charge at all times. Flow meters are fitted to the gas and air supply lines.

Safety arrangements

Very comprehensive safety arrangements are built into this furnace, including the provision of both visual and audible warning in the event of failure of electric motors or the water supply to the cooling zone.

Like all the equipment at the Britannia works, this furnace has been carefully laid out for ease of operation and control.

There is ample room at each end of the furnace for loading and unloading operations and at each side for

inspection and maintenance of the burner arrangements.

A special feature is the well designed control panel which is sited well clear of the furnace but in a good position for observing its action.

The Kent recorder/controllers—one for each zone of the furnace—have been incorporated in a well-lit control panel with facilities for storing record books and other relevant material and a desk at the ideal height for entering the readings taken from the recorders, which are at eye level.

Readings are taken regularly at intervals of one hour.

This furnace was installed in 1949 and replaced the original gas-fired furnace which ran continuously from 1933 until 1949 without shut-down.

More recently, a basically similar furnace has been installed beside the one just described.

Sorting stand

From the annealing furnaces, the pots of heat-treated castings including ore are conveyed to a vibrator which separates the fittings from the ore and places them on a conveyor running along a sorting stand where the various items are sorted into appropriate bins.

At this point, a second test is made for malleability. A sample is taken from each pot and subjected to a flattening process, in the course of which no fracture must occur.

Grinding follows and a further check for angle correctness and alignment. Should any fittings have become slightly distorted during the annealing process, they are sent for rectification.

Smaller fittings are treated in specially designed presses in a cold state but the larger items, generally speaking, those with diameters above 2 in., are heated in gas-fired muffle furnaces to temperatures of the order of 700°C. in readiness for correction on appropriate jigs and mandrels.

Cleaning up

A cleaning up process follows in which the fittings pass through tumbling barrels containing abrasives or shot-blasted according to size and type.

A conveyor takes the fittings to another inspection department where their surfaces are carefully examined and the screwing size of each fitting is checked by 'go' and 'not go' gauges.

At this point, all fittings which have passed the strict testing schedule are in the familiar 'black' finish in which many of them are supplied to the customer.

These fittings are now ready to be passed to the threading department. Nearly 50% of the fittings are sold in galvanised form, however, to give added protection against corrosion.

These fittings are sent to the firm's galvanising department.

There are two galvanising baths, each holding 12 tons of zinc in molten form and both heated by gas. The burner equipment on each bath consists of two air-blast burners.

In order to avoid local over-heating of the galvanising bath, the burners are adjusted to give a fairly slack flame. The method of treating the fittings is to load them on to suitably designed racks, lower them into the bath for a given period and quench them in a water tank.

Both galvanised and 'black' fittings meet up again in the threading department where batteries of specially-made machines of the Britannia Iron and Steel Works Ltd. own design cut the threads automatically.

The fittings move on to a turntable associated with the machine which picks them up automatically and positions them accurately while the thread is cut.

The machines will not operate unless the fitting is being held dead true in the jig. In addition to cutting the thread, the machines also chamfer the face of each fitting to prevent the thread being burred over during subsequent handling and fitting.

Final testing

When they leave the threading machines, the fittings have nearly reached the end of their progress through the works although they still have to undergo their final testing, varnishing (to provide protection during storage and transit) and 'pass-out' inspection.

In the testing department, the fittings are placed on jigs and hydraulically tested to a pressure of 350 p.s.i. and any which prove to be leaky are rejected.

The final inspection includes gauging and visual examination to ensure that every fitting which leaves the Britannia works will do so in perfect form and with threads of the correct specification.

It will have been noticed that in addition to producing the **GF** casting, the Britannia Iron and Steel Works Ltd. also design and manufacture a considerable amount of the equipment used in producing these castings.

Among the items manufactured in this way are the taps used in the threading of the fittings. These taps require hardening and this is done in gas-fired I.C.I. cyanide furnaces.

These have a pot diameter of 2½ ft. and are fired by twin air-blast burners while the products of combustion are used to heat a separate pre-heating pot before venting.

About 900 people are employed at the Britannia works and a high standard of comfort and amenities are provided for them.

This particularly applies to the foundry workers whose accommodation includes individual lockers, wash fountains and showers.

Hot water

Hot water for these is supplied by an Ideal 1 GBB.7 boiler, coupled to a 300-gal. indirect storage cylinder.

Water heating arrangements elsewhere in the works include Potterton boilers for cloakrooms and wash-basins with instantaneous sink water heaters fitted in all works offices.

Space heating in most of the various departments is also by gas, the equipment including 'Weldex' indirect gas-fired unit air heaters and Bratt Colbran luminous panels.

A works of this size requires considerable canteen facilities and the well appointed canteen, providing meals for about 250 persons daily, is all gas, this fuel being used for cooking, water heating and space heating.

Although to the gas engineer it is the **GF** pipe fitting which springs to mind when the name of the Britannia Iron and Steel Works Ltd. is mentioned, the Company does not restrict itself to the manufacture of these components only but will produce malleable castings to the special requirements of firms in any industry.

Customers

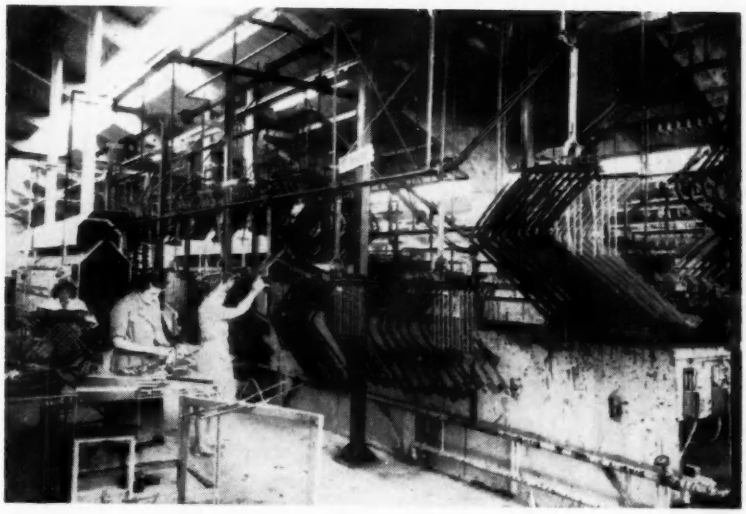
In fact, the firm's customers include well-known manufacturers of cars, cycles, agricultural machinery, textile, electrical and mining equipment, which are some of the main fields in which malleable castings find important applications.

In all these industries, as well as in gas supply, the **GF** malleable casting is known and appreciated and the Eastern Gas Board is particularly happy to include the Britannia Iron and Steel Works Ltd., of Bedford, among its many industrial customers.

Large gas order for new Ford factory

THE Ford Motor Company has agreed to take up 2¾ mill. therms of gas a year from the North Western Gas Board for use mainly in ovens for drying car bodies, and later for other processes, at their giant new factory now under construction at Halewood, near Speke, Liverpool.

AN AUTOMATIC FINISHING PLANT FOR NEW MOTOR PARTS FACTORY



The finishing plant installed by Parkinson Cowan Industrial Products in the new John Bruce factory. This plant comprises dip tanks, conveyors, and infra red gas-fired paint stoving ovens.

A COMPLETELY automatic finishing plant—designed and installed by Parkinson Cowan Industrial Products—is now working in the impressive new motor components factory of John Bruce (Engineers) Ltd. at Oxford.

The product finishing plant takes the form of two distinct systems. One handles 1,750 pressed components per hour at a stoving cost of about .08d. each; the other system handles channel-formed components at the rate of 6,000 per hour, each component being stoved for about .02d.

Two overhead conveyors, two gas-fired radiant heat stoving ovens and two paint tanks comprise the complete installation.

Chain conveyor

The main finishing line handling pressed components has a 122-ft. overhead chain conveyor moving at a mean speed of 3 ft. per minute and carrying jigs at 3 ft. 6 in. centres.

Each component is loaded on to the jigs and makes two circuits of the conveyor route. On the first circuit the component is automatically dipped into a 15 ft. long recirculating paint tank—divided longitudinally into primer coat and finishing coat compartments—and then passes to the oven for the first stoving process.

Oven length

The oven has an overall length of 21 ft. with a heated area 15 ft. long by 4 ft. high and with 3 ft. long sheet metal vestibules at each end. A total of 30 radiant heat panel units, each 36 in. wide by 19 in. high, are arranged in two banks to provide the heating area and have an average gas consumption figure of 1,200 cu.ft. per hour. (Maximum gas consumption of this oven is 1,500 cu.ft. per hour).

Oven temperature indicators and electronic constant temperature controls are fitted in order that there is constant heat throughout the whole of the heating area and that gas consumption is minimised.

When the conveyor carriers return to the loading point, pressed components which have been primed are moved to the other side of the jig so that their next circuit takes them through the finishing coat compartment in the paint-tank.

Unpainted components are put on the 'primer' side of the jig. After the next circuit, the original component is finished and replaced on the jig by the primed component.

Another unpainted component is then mounted on the 'primer' side.

A similar layout is used for the channel-formed component finishing line except that only one coat of paint is required and therefore the paint dip tank has only one compartment.

The radiant heat oven in this line has an overall length of 18 ft., the heated length being 12 ft. comprised of 24 panel units.

Average gas consumption of these units is 960 cu.ft. per hour, their maximum consumption being 1,200 cu.ft. per hour.

Engine safety control

OF particular interest to designers and users of gas, diesel and petrol engines, the new engine safety control introduced by Honeywell Controls Ltd. provides positive protection against the pressure variable dropping below, or the temperature variable exceeding, the safe value; the controller instantly stops or idles the engine and/or actuates an alarm circuit.

The unit has been designed to withstand severe vibration; pressure and temperature settings cannot drift, with consequent false engine shut-down. To actuate the final engine control element or alarm circuit, each system has an independent Honeywell change-over micro-switch which is itself unaffected by vibration.

Temperature and pressure scales, clearly visible through windows in the front of the case, are located with setting adjustment spindles inside the case for protection against tampering. They are conveniently reached on removing the case front.

The temperature measuring system has an exclusive fail-safe feature; in the event of damage to the sensing elements, the controller responds as for excessive temperature, stopping the engine. An external knob, located on the front of the instrument, provides manual start and stop of the pressure mechanism; from 'Start' it automatically switches to a 'Run' position when the oil reaches its operating pressure. The 'Stop' position is used for routine engine shut-down.

The development . . . of industrial . . . gas sales . . . in North Wales

It is now a matter of history to record the downward phase of industry between the two wars and the subsequent soul-destroying effects of unemployment which perhaps had a greater effect in Wales than anywhere else in the country. The Government, realising the necessity of finding alternative employment, appointed commissioners under the Development and Improvement Act of 1934. Their task was to facilitate economic development and social improvement in specified districts, including South Wales, which had the most severe unemployment.

Their aim was to attract expanding industries which were growing in the Midlands and the South of England to the special areas. Profiting from the experience of private companies which had already developed trading estates in other parts of the country, they located similar estates in these districts. One was formed in South Wales, now known as the Treforest Trading Estate, and one at Wrexham for the North Wales area. The Wrexham and district area was scheduled in 1946. This was no doubt influenced by the relatively high unemployment which existed both before and after the war in an area so largely dependent on coal mining.

A temporary easement of these difficulties was effected by the establishment of a Royal Ordnance Factory but with the closure after the war the pre-war conditions were again experienced. Under the Schedule this factory, which consisted of many small units, was then converted to the Wrexham Industrial Estate. It is well to remember the acute unemployment which was felt mainly in the counties of Anglesey, Caernarvon, Merioneth and Montgomery just before the war and chiefly in such places as the slate quarry areas of Nanttle Valley and Blaenau Ffestiniog and in Holyhead and Caernarvon.

Resulting from the energetic representation of local councils and Members of Parliament a vast improvement has been effected in the number of unemployed, due to the establishment of new industries and the expansion of old ones in a number of towns in these counties. Government-owned war factories were turned over to civilian production at Newtown, Beaumaris, Llandudno and Bangor with new factories and extensions to existing ones having been built at Bethesda and Welshpool, St. Asaph, Conway, Nanttle Valley, Denbigh and Deeside.

by
J.A.W.STRETTON
Senior
Industrial
Gas Engineer,
N. Wales

THE industrial outlook in North Wales is much changed in the last decade. Indeed, I feel very honoured to have had the opportunity of playing a small part in its expansion and what is more important, the associated development of gas sales. Any story of industry, wherever it may be situated, is always an interesting one, and this area is no exception. The diversity of trades and processes is growing each year and despite keen competition from other fuels gas sales are keeping pace.

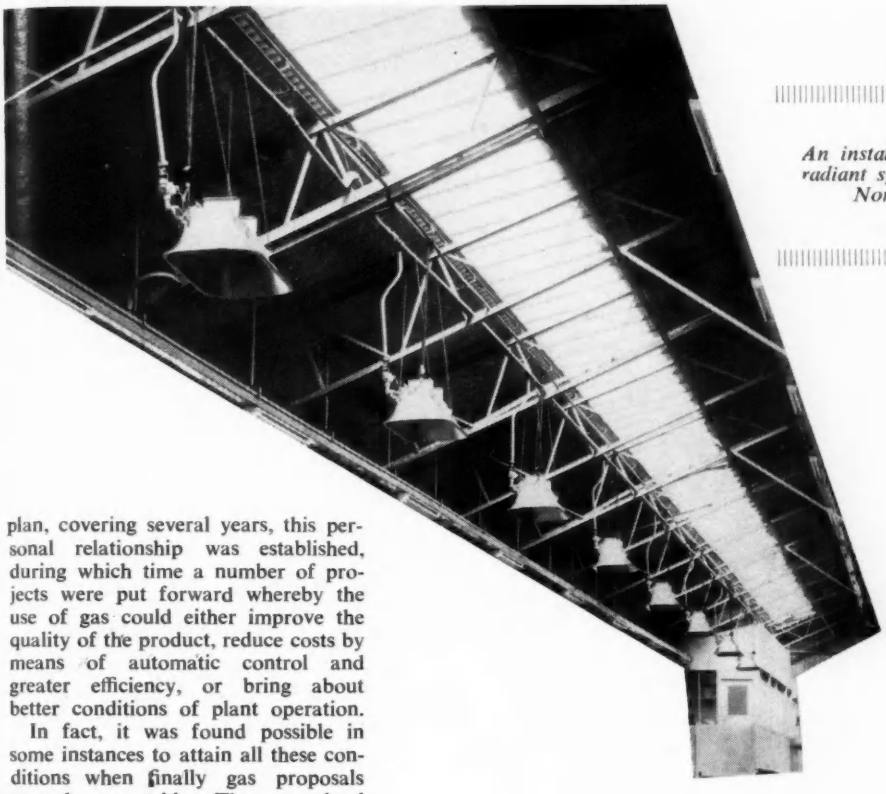
Ten years ago it could be said that one of the largest chemical works had very little use for gas except perhaps for bare essentials. The bulk of their fuel usage was heavy oil, with large quantities of low grade coal, electricity and steam from their own generating plant, and the introduction of gas for use on stills, autoclaves, chemical reactors, powder drying and other plant which, for so many years, has been operated on the cheaper fuels is the result of long-term planning and continuous service.

SURVEY

As a first step a complete survey was made of existing plant to determine where gas might have the best chance of success in any proposed conversion. The determination of this factor meant that the chemical engineers had to be persuaded to discuss their various processes fuel-wise with the industrial gas engineer, no easy task in an industry where competition is keen and every process is on the secret list.

This kind of selling calls for much patience with the first objective being to establish a personal relationship with management in every department of the firm.

By the development of such a sales



An installation of 84 overhead radiant space heating units in a North Wales factory.

plan, covering several years, this personal relationship was established, during which time a number of projects were put forward whereby the use of gas could either improve the quality of the product, reduce costs by means of automatic control and greater efficiency, or bring about better conditions of plant operation.

In fact, it was found possible in some instances to attain all these conditions when finally gas proposals proved acceptable. The gas load grew from 52,671 therms in 1950 to 235,235 therms in 1959.

And what of the glass industry? The advent of grid supplies of gas enabled the Board to secure substantial loads which would previously have been impossible. Pilkingtons is a name synonymous with glass, and in the further development of specialised products, scientific instruments, optical, windscreen, and glass for other specialised uses, it was necessary that a factory should be established in a clean air zone.

EXTENSIONS

Three years ago such a factory was built and put into commission, with further extensions being made in the present year and work now in progress to more than double the original site area.

At this factory gas is used for the manufacture of glass from basic powders and, in a molten state, it is fed to automatic gas-heated moulding presses, thence to gas-fired annealing lehrs and to final inspection and packing. For special orders the glass 'gobs' are moulded by hand operations in separate smaller furnaces.

Gas is used for centrally heating the factory and offices and also at a well-equipped canteen.

The gas load for the last three years has developed from 151,900 therms in 1957-58 to 412,425 therms in 1959-60.

Another smaller industry was established about the same time and deals with the reconditioning of television tubes.

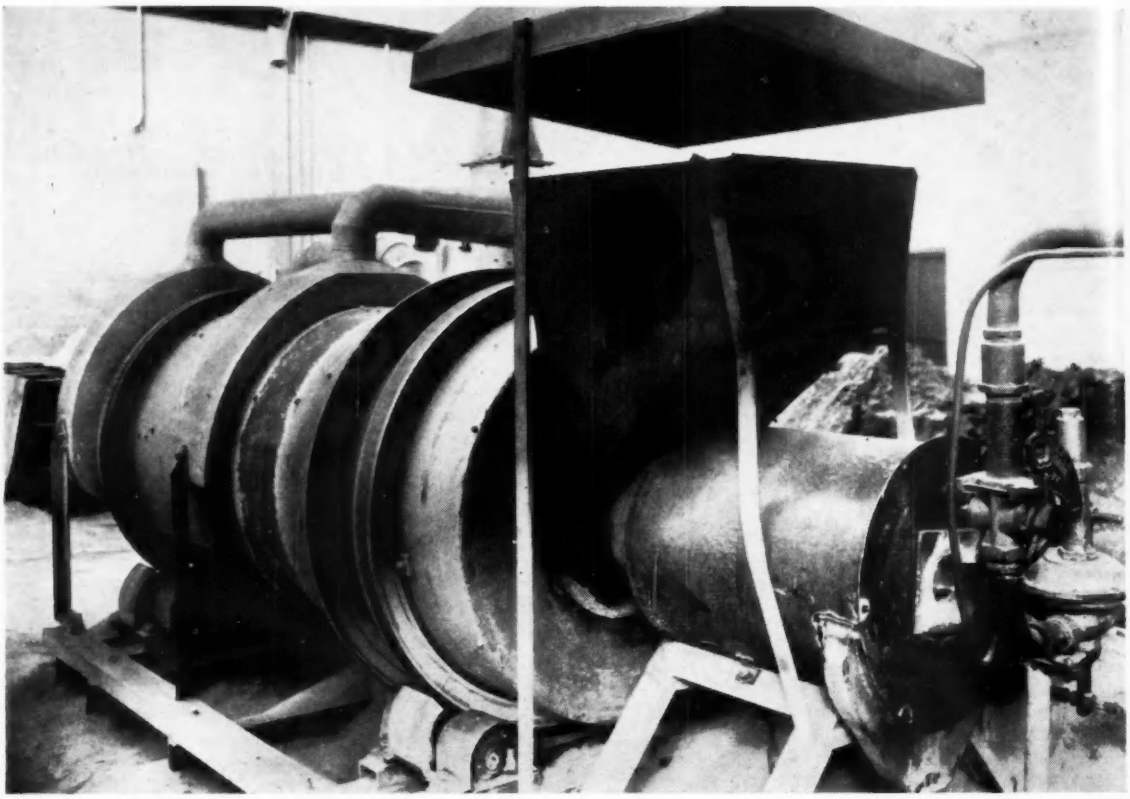
Briefly, the process involves cutting the neck of the defective tube, removing the electron ray gun and refitting a new gun.

In so doing the tube is heated to a temperature of 400°C. and by connection to a pump is simultaneously exhausted of air and gases to create a vacuum. When these conditions are attained the tube and new gun are welded together and the whole allowed to cool in the furnace.

Assistance was given to this firm in designing and making their own gas-fired heating furnaces, with the adaptation of a capstan type lathe, equipped with pin type burners to heat and melt off the neck of the tubes.

The development of gas sales at A.E.I. (Hotpoint) Ltd., Llandudno

This St. Asaph works kitchen uses gas to great advantage daily.



This rotary sand dryer in a North Wales foundry has been converted from oil to gas firing. Its output?—one ton of dried sand an hour.

Junction, has been most encouraging. In the manufacture of electrical goods, mostly washing machines and refrigerators, the bulk of the gas load is derived from paint stoving. Until recently this work has been carried out in comparatively small oven units, either of the standard, convected warm air type or by short infra-red tunnels.

Due to rapidly growing production the factory has been extended, and reorganised as the result of applied work study to give continuous drying of components such as the washing machine body, wringers, top covers, etc., and to eliminate handling, an expensive item in factory economy.

TRANSPORTATION

The conveyorised plant deals with transportation from stores to the various operations from press to press, degreasing, spraying, etc., and making the best use of available space, the gas-fired, infra-red tunnels have been built as two decks in tandem with the top oven supported by a gantry.

In the drying tunnel for the cabinet plant, used for primer and finish coat, the assembly comprises 198 infra-red panels, 100 ft. long on the lower deck, and 156 panels, 78 ft. long on the upper deck, operating at a temperature of 500°F. giving a stoving time of 12½ min.

At the date of installation the plant was handling 180 cabinets per hour conveying the primer through the lower oven and the finish coat via the upper oven.

Control of temperature is carried out thermostatically by relays to a central control panel where switches enable the plant to be operated on by-pass during breaks for lunch and shift working.

With an existing gas load of nearly 3 mill. cu.ft. per week, this firm is already planning for further extensions.

A factory was started some six years ago for anti-corrosion treatment of metal by means of a plastic coating. The process, operated under American licence, commenced primarily for the reclamation of metal plant and equipment as for example, ships propellers, acid vats, pipes, valves, food processing containers, fans and extract ducting. It has since been extended to the treatment of new equipment.

SPRAY COATINGS

Generally, the process involves three or four spray coatings of liquid plastic, with each coat oven-baked at temperatures ranging from 200° to 400°F., depending upon the characteristics of the plastic being used.

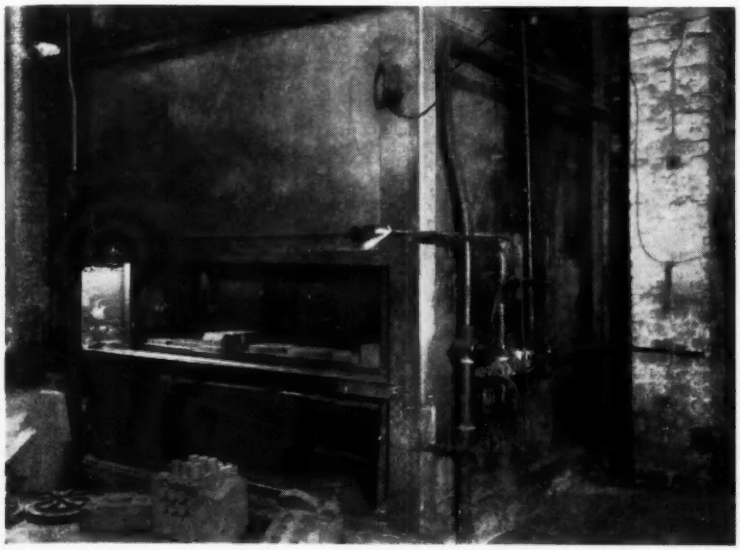
Several gas-fired ovens are in operation for this work and recently a special indirect fired oven has been erected to take up to 30 tons load.

The oven is 31 ft. 6 in. by 11 ft. 6 in. by 11 ft. 9 in. high and used for plastic drying on the larger types of plant such as bulk liquid transporter tanks, acid vats and 30 ft. long pipes of various diameters. The maximum gas rate for this oven is 6,000 cu.ft. per hour.

SHROUDING

It has been found that even with an oven of this size there are many applications too large or not transportable into the factory premises. These are dealt with by shrouding with insulated coverings and connection to portable gas fired air heaters. Such work is either carried out in the factory yard or on the customers own premises. The annual gas consumption at this factory is approaching 3 mill. cu.ft.

Several small iron and steel foundries are now operating in North Wales at places as far distant from each



A 20-ft. high swing tray continuous core drying oven converted to gas firing.

Below: A lathe has been adapted to take oxy-coal gas burners for reconditioning television tubes.

other as Bangor, Pen y Groes, Buckley and Llanidloes.

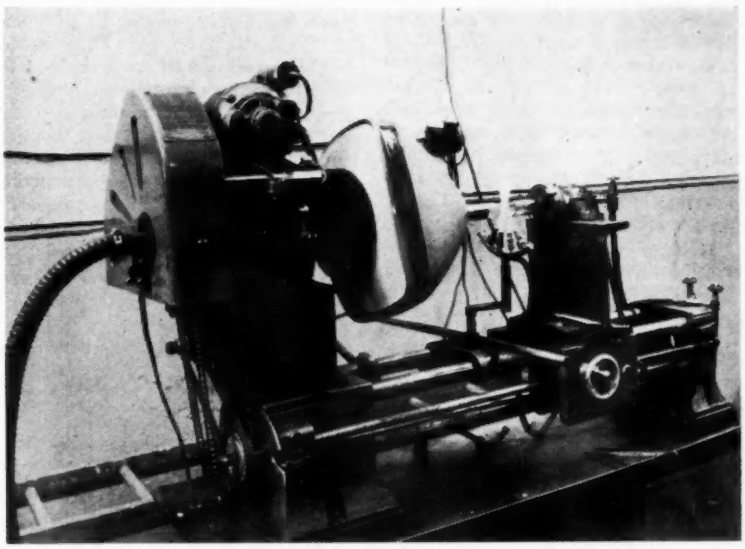
Most of these use gas for such processes as sand drying, some by means of continuous rotary dryers, one such being recently converted from oil fuel. For mould and core drying ovens and for ladle heating, equipment has been converted from other fuels to gas firing. Annual consumptions at these foundries vary from 1 to 3 mill. cu.ft. and, in the case of one of them, represents some 40% of the local undertaking's gas sales.

GAS LOAD

Although we are not in the true sense an industrial area by comparison with the Midlands, Merseyside and South Wales, our gas load is a substantial one and has the advantage of comprising a wide diversity of products via many small factory units.

In addition to those applications for gas already described there are of course many others for which time does not permit a full description, but might be briefly mentioned as follows:

- **A RAYON firm uses gas in the production of carbon dioxide as a purge gas used in the catalyst plant for the reduction of chemical smoke and vapours.**
- **MILLBOARD manufacturers sample test their products for inflammability by means of a radiant heat furnace, and further project work is in hand for a continuous drying process of sheet millboard.**
- **CONVERSION of methanol to formaldehyde—silver catalyst chambers are preheated by ribbon flame burners to start a chemical reaction.**



All these kinds of uses for gas in industry include, in addition, the 'bread and butter' application to most areas, for example, for degreasing and rinse tanks, chromium plating, paint stoving by convection or radiant heat ovens, space heating and works canteen kitchens.

The volume of work in hand and the known contracted loads indicates the amenity value of gas apart from reasonable price differentials, with other fuels, and with this virile industry there is great promise of increasing gas sales in the industrial and domestic markets.

Leaflets from 'Incandescent'

THE Incandescent Heat Co. Ltd. has produced a new leaflet No. V61, entitled 'Radiant-Jet Furnaces.' This leaflet gives information of features of these furnaces, as well as optional extras and sizes in which the furnaces are made. This Company also has two leaflets, Nos. 59 (1) and (2), entitled 'Incandescent Gas Atmospheres Division—What we make.'

Gas keeps them flying

SOME OF THE WAYS IN WHICH GAS HAS CONTRIBUTED TO ESSENTIAL DEVELOPMENT WORK IN THE AIRCRAFT INDUSTRY

THE aircraft and allied industries occupy a leading place in manpower requirements in the South West, and their status with regard to gas consumption is rather similar. Of the South Western Gas Board's total industrial gas load this industry accounts for approximately 10%. The following article outlines some of the developments which have shown enterprise and which have enabled the Board to identify themselves to some extent with the aircraft industry's vast programmes of research and development.

During 1956 Normalair Ltd., of Yeovil, were progressively increasing test facilities at their High Altitude Laboratories in Yeovil. Included in their research equipment are numerous decompression chambers the largest of which is capable of accepting aircraft specimens containing the complete aircraft air conditioning and pressurisation system. These systems are tested in the chambers under artificially reproduced and carefully controlled conditions of flight.

'Ram' effect

In the aircraft during flight the air supply to these systems is obtained by means of engine-driven blowers or by tapping the main engine compressor. This is delivered to the cabin at high pressures and temperatures due to 'ram' effect and the mechanical compression. It became necessary to reproduce these conditions of pressurised air at elevated temperatures, and during early 1956 this firm requested from the Gas Board's area industrial department a design of a town gas/air heat exchanger suitable to their specific requirements. These were as follows:—

1. Delivery of clean air, at mass flows up to 58 lb. per minute.

2. To be capable of withstanding air pressures up to 250 p.s.i.g.

3. Maintenance of maximum of air flows at temperatures up to 1,100°F.

There appeared to be no record of similar plant in this country operating on gas or any other fuel.

In early 1957 the plant, designed by the area industrial department, and constructed by Industrial Furnaces Ltd., was commissioned for use and has since then become an integral part of Normalair's research programme.

The heater is a compact sheet steel-clad furnace, suitably lined with refractories and divided into a combustion chamber and four heating zones by refractory walls having alternate upper and lower connecting passages. Overall dimensions are: Length 10 ft. 8 in.; width 4 ft. 8 in.; height 10 ft. 2 in.

The hot combusted gases flow alternately upwards and downwards throughout the length of the heater and finally enter the recirculating fan which returns the hot products to the combustion chamber. A flue is connected to the fan outlet for the necessary effluent gas spillage. High pressure air enters at the outlet gas zone via a 4-in. diameter header, and extending from this a hairpin arrangement of tubes traverses the air through this zone and terminates in a similar header at the top of the next adjacent zone. The air flow progresses through each heating zone in the same tube and header arrangement until the combustion chamber where the tubes follow the walls, roof and floor, and the processed air is finally collected in an external header leading into the delivery control system. The tubes 1¼ in. o.d. by 10 gauge and the headers are of stainless steel.

From a paper 'Recent Industrial Gas Development in the South West,' presented to the South Western Section of the Institution of Gas Engineers last month by K. G. Eccleshare and C. H. Hirst.

Low pressure gas, via the governor, main and by-pass magnetic valves, passes to a single Hypact burner fitted vertically through the combustion chamber floor. Flame failure protection is provided by means of the Ether Wheelco Flame-Otrol equipment using flame conductance from a pilot jet to the electrode.

Control panel

The control panel consists of the following instruments:—

1. An air temperature indicator with a preset-set control needle which cuts out the main magnetic gas valve when the desired temperature has been reached.

2. Combustion chamber temperature indicator.

3. Air pressure switch in circuit with the main and by-pass magnetic valves which prevents gas passing to the burner until the air flow pressure has reached 20 p.s.i.g.

4. Exhaust fan control switch with three positions—(a) normal running—gas passing to burner, (b) stop-gas cutting out with the fan, and (c) purging fan working but no gas passing to burner. (The latter position is used for purging the furnace atmosphere prior to starting up the plant.)

Gauges

5. Pressure gauges—(a) working gas pressure, in w.g., (b) air pressure in tubes p.s.i. and (c) exhaust fan, pressure in w.g.

No gas can reach the burner until all the following conditions have been obtained: 1. Exhaust fan working, 2. pilot light established, (3) air mass flow at 20 p.s.i.g.

Control of temperature is effected by means of the indicator/controller. Until the preselected temperature is reached both the main and by-pass magnetic valves are open and the full gas rate is passing to the burner. At the selected temperature, the main magnetic valve closes and a panel light indicates this operation. Thereafter, the main magnetic valve opens or closes with variation of outlet air temperature. The amount of gas passing through the by-pass valve is adjustable; adjustment to this may be necessary to suit low temperature and air flow conditions.

Air mixing control

Normalair Ltd. have installed, downstream of the heater, air mixing control equipment. This enables the temperature of the air mass flow to be varied to suit the test rig experiments, irrespective of constant conditions being maintained at the outlet of the heater.

The first official performance test took place on February 14, 1957. The primary objects of this test were as follows:—

1. To obtain a representative curve for the 'heating-up' period, starting from cold conditions.

2. To observe and record the temperature of the combustion chamber and the outlet air under varying conditions of air mass flow and air pressure.

3. To ascertain the cooling rate with gas cut off.

4. Thermal efficiency.

Prior to the completion of the plant at Normalair interest in these facilities was mounting and, following upon an enquiry by the Area Industrial Engineer to the firm of Rotol Airscrews Ltd. the Gas Board was quickly engaged on a similar project.

Air mass flow

The requirements here were similar in respect of the air temperature and pressure but a much greater air mass flow was involved, namely 2.5 lb. per second as against the 1 lb. per second for the Normalair plant.

Some improvement in design technique led to a reduction in the relative size of plant. Generally however, the main design features were based on the earlier prototype and the system of control and instrumentation was fairly identical.

This plant was commissioned during the summer of 1957 and was soon fully operative as an integral part of the special testing facilities of this firm. Later, following increased demand for testing, an additional air heater was installed by Gibbons Bros., of Dudley.

At the Patchway works of Bristol Siddeley Engines Ltd. the Board's efforts have for some time past been concentrated mainly on two special divisions where projects offered opportunities both of increasing existing gas loads and also obtaining new ones. In view of the apparently limitless scope for high duty materials these two divisions, the Ram Jet Department and the Precision Foundry, are worthy of special mention.

Alongside the numerous and important development projects already commissioned on this site a further feature of the intensity of the research work has been in the design and installation of an engine combustion research rig for work on the thermodynamic and aerodynamic research problems in connection with the maintenance of efficient combustion and heat transfer within a ram jet engine.

With the progressive development of higher powered engines the need has arisen to simulate flight conditions at speeds up to Mach = 4.0, i.e. four times the speed of sound.

Heat exchangers

In order to achieve this it was necessary to incorporate in the combustion rig some form of heat exchangers capable of raising the engine air supply temperature to 650°C. This temperature represents the ambient temperature at the engine intake at Mach = 4.0.

In addition to combustion research work such facilities as the above rig afford include full scale testing of engine components, e.g. air driven turbo fuel and hydraulic pumps. All these can be submitted to realistic environmental tests covering bearing life, fatigue of turbine rotors and other highly stressed components at elevated temperatures; also the behaviour of fuels, response rates of servo mechanisms and all manner of investigations necessary to ensure the reliability of Bristol Siddeley ram jets.

During negotiations early in 1959 for the provision of suitable gas-fired equipment, the Test Facilities Department of Bristol Siddeley Engines specified certain stringent requirements of the plant to be designed. Most important were the following:—

1. Delivery to their pilot test combustion rig of clean air at mass flows up to 600 lb. per minute.

2. This delivery to be made at pressures up to 200 p.s.i.g. and maintained at temperatures up to 650°C.

3. The plant to be capable of maintaining deliveries down to 60 lb. air mass flow per minute at 120°C.

An important new aspect had now arisen in the development of air heaters—the air mass flow requirement at 10 lb. per second was four times the amount necessary for the previous plant at Rotol Ltd. This obviously involved design economy and a fresh approach to the layout of the heat transfer tubes was studied.

It was finally decided that the air heater plant should comprise two separate units of equal capacity, each to deliver 300 lb. per minute air mass flow, and that either one or the two units in combined operation would satisfy these demands.

Co-operation

In co-operation with the Gas Board's area industrial engineer and the West Midlands Research Station (Gas Council) the plant was designed and manufactured by Industrial Furnaces Ltd., Kingswinford, Staffs.

The two heaters are identical, the overall dimensions being 4 ft. 6 in. diameter and 14 ft. high. The combustion system comprises three high velocity air blast tunnel burners firing downwards through a central combustion chamber lined with stainless steel tubes. At the base the hot gases are diverted upwards through a special tube system and at the uppermost section are ejected to atmosphere.

The high pressure air is admitted via a top inlet header, passed downwards through the outer special tube system, then upwards through the stainless steel tubes, and finally collected in the outlet high temperature header.

At the base an intermediate header which changes air direction from downward flow (outer tubes) to upward flow (stainless steel tubes), has special characteristics for allowing expansion due to heat and shock changes of air flows and pressures.

Solenoid valves

Gas is supplied to each heater through a 6-in. zero governor and then from a common manifold the supply to each burner is induced through separate restrictors and solenoid valves.

Medium pressure fan air connected to each burner is separately controlled by both solenoid-operated relay valve and adjustable by-pass arrangements. The air is discharged into the mixture tube through an orifice thereby inducing gas via the zero governor and restrictor and resulting in almost stoichiometric conditions at all rates of flow.

The control equipment includes the following:—

1. A strip chart indicating temperature controller sensing from a thermocouple positioned in the air outlet header and operating with the proportionating valve in the combustion air supply to the burners.
2. An indicating temperature controller sensing from a thermocouple positioned in the combustion chamber. This control operates a gas cut off in the event of overheating.
3. An electronic programming unit for each burner.
4. Flame failure protection is provided by a lead sulphide type sensing cell fitted at the head of each burner.

Proving trials have been satisfactory and the plant is now fully commissioned and in use.

During the final stages of the above installation the Ramjet Department made known their future requirements for high temperature air in connection with hypersonic flight problems. In consequence Bristol Siddeley Engines Test Facilities put out a specific enquiry for a heat exchanger to supply a mass flow of 10 lb. per second at 300 p.s.i.g. and at 1,700°C. This temperature, of course, far exceeds the material limits of conventional heat exchangers and attention was therefore focused on a pebble heater. Since then the firm of Industrial Furnaces Ltd., in co-operation with the Gas Board's Area Industrial Department and the Gas Council has put forward the basis and a quotation for the design and installation of a regenerative type pebble-bed heater.

Heating cycle

The heating cycle will be a 'down run' with the gas burner at the top, water cooled and firing either tangentially or directly downwards into a combustion chamber. Preheat for the combustion air will be provided externally. The hot gas down run may be of several hours duration. Pressure air will then be admitted at the base and the process air cycle which will be an 'up run' may only continue for about 10 minutes. The temperature gradient from the combustion chamber to the support grate or arch is likely to be of the order 1,800° to 600°C. and the refractory materials for the heater inner lining and the 1½ in. diameter pebbles will be correspondingly graded from pure alumina bricks at the top to 42% alumina bricks at the grate.

Among the many fresh problems encountered with a project of this nature is that of assessing reliable design heat transfer co-efficients. Although much data is available on this subject for packed beds, they are known to spread over two orders of magnitude for any one Reynolds number value.

Investment casting

The change from piston engines to turbines required new techniques in the manufacture of turbine blades and housings which require intricate shapes cast in new materials capable of meeting the temperatures and stresses encountered in modern engines.

The investment casting technique sometimes referred to as the 'lost wax' technique of casting began its industrial career in this country some 20 years ago in the production of aircraft engine component parts. It is now well established and recognised by engineers as yet another production process with which complicated shapes can be made and affording considerable scope to the designer.

Briefly described, the process commences with the manufacture of a die containing the negative shape of the

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pattern from which the expendable patterns are produced. Steel or aluminium machined dies give the highest accuracy in the expendable pattern and maximum die life. Cast dies have some advantages and the material found most suitable for these is the bismuth alloy series.

From the die expendable patterns are produced. The material used is a composition of paraffin and carnauba waxes with flexoresin. The heated wax is injected to the die by machines having high (500 p.s.i.g.) and low (80 p.s.i.g.) pressure systems.

Clustering stage

Patterns thus produced then move to the assembly or clustering stage. This entails joining a number of patterns to a main runner and fixing a feeder gate.

The completed wax assembly receives its primary investment by immersion in a slurry of bonded refractory material and is then suspended from a vibratory unit and while still moist is given a further coating or spray of coarse refractory material.

Then follows next the secondary investment where the coated wax assembly is placed in a moulding box on a vibratory table and a travelling mixer discharges the investment around the assembly. Low temperature mould drying and removal of wax pattern follows.

The mould is now fired for a predetermined period at around 1,050°C. Casting takes place as the mould is withdrawn from the firing furnace. Finally, fettling and inspection of the cast component.

It is, of course, with the low temperature drying or 'melt out' of the wax pattern and later the firing and 'burn out' of the mould that gas plays a prominent part.

Mould production

Originally the low temperature operation was carried out by means of indirect fired high pressure air circulation ovens. As a result of constant laboratory research and experimentation a further development to merge in the investment field has been the refractory shell technique of mould production. In the process the 'melt out' of the expendable pattern takes place immediately following the primary coating or investment, and consequently the primary coating is repeated several times until a shell thickness of $\frac{3}{16}$ in. is obtained.

The heat requirements for removal of the wax pattern could not now be satisfied by the air circulation ovens. Some means of heating the shelled assembly had to be sought whereby the layer of wax nearest the inner shell lining received rapidly conducted heat sufficient to cause shock melting, thus leaving a space between pattern and shell. This rapid initial melting is necessary in order to avoid shell rupture due to expansion pressure as the pattern heats to its melting point.

Although several methods are available for the above technique, the present production needs at Bristol Siddeley Engines are being met by means of heated fireclay grog of size $\frac{3}{16}$ in. to 0. A gas-fired plant designed and installed by Modern Furnaces Ltd. provides an output of 2,000 lb. per hour of grog at 300°C. ± 10°C.

The grog is taken to an overhead feed hopper by bucket type elevator and discharges with regular flow to an inclined rotary drum type heater. The heater outlet delivers the heated grog to a small collector hood to which is fitted a distributor pipe system for the rapid distribution of the grog around the shell pattern, this being held in a special nimonic container and positioned on a vibratory unit, thus ensuring quick and efficient packing of the hot grog into all pockets or voids of the shell. When correctly filled the container moves to the next and firing stage. The heat input is provided by a single vortex burner, the combusted gases being in contra flow with the moving grog. A recording controller senses from a thermocouple fitted in the outlet collector hood. The entire plant is contained in an envelope of approximately 20 ft. by 10 ft. by 16 ft. high.

Along with the various progressive steps aimed at higher productivity and consistency in the quality of the castings it became obvious that the existing firing furnaces were in need of replacements, and with the introduction of vacuum arc melting additional furnace capacity was a first essential. During August, 1959, an order was placed with Industrial Furnaces Ltd. for the supply and erection in the new vacuum arc melting section of a bogie hearth furnace of the following overall dimensions: Length 34 ft., width 11 ft. (including trolley return track), and height 12 ft. (including recuperator).

This furnace is designed for continuous operation to heat cylindrical moulds of dimensions up to 9 in. diameter and 15 in. high to a temperature of 1,000°C. Each mould weighs approximately 40 lb. and the output on continuous working will be 10 moulds per hour.

Conveyance trolleys have special refractory tops with side encasements of nimonic sheet steel and are propelled by a rack and pinion type pusher. The trolleys are sand sealed during their movement through the furnace. After reaching the side unloading door, which can be pneumatically or manually operated, the trolleys pass under a heat retaining wall to a cooling chamber and then to the transfer bogie and return rack for reloading. The furnace is loaded via an entrance vestibule where the doors are manually operated only.

Mixing burners

Heating is provided by means of low level air/gas nozzle mixing burners firing at an angle of 30° behind a box brick wall. The burners are connected in two zones, each having a motorised valve controlling linked air and gas flows and operating from indicator controlling instruments.

The furnace brickwork consists of 9-in. hot face insulation bricks backed up by 9 in. of diatomaceous insulating bricks.

In April, 1959, this furnace was commissioned and a further similar installation was commenced in June of that year and has now been in production for several months.

Among the many gas-fired installations which have been newly commissioned within the past year at Douglas Ltd., Kingswood, it is perhaps disappointing from the viewpoint of this paper that the majority of the plant is of conventional type. These installations include foundry ladle heating equipment, annealing furnace, aluminium alloy solution and precipitation treatment ovens, low temperature infra red and forced air continuous stoving and treatment ovens, alkaline degreasing machines, a cyclic annealing furnace and a radiant jet furnace. The last mentioned is, however, unconventional in design and despite the acknowledged use for many years of radiant tube furnaces, this is considered worthy of mention.

Radiant tube

A radiant tube furnace is virtually a muffle type furnace, i.e., one in which the products of combustion do not enter the working space. Conventional radiant tubes are of single pass design, the burner firing into the tube at one end and the hot gases travelling along to exhaust at the opposite end. There is a tendency for hot spots to occur and the efficiency is not high.

This radiant jet furnace, a product of the Incandescent Heat Co. Ltd. incorporates their Jetube radiant heat-

ing elements. The combustion chamber adjoins the main tube circuit so that only products of combustion circulate within the tube. An air/fuel mixture is injected under pressure into this refractory lined, retractable combustion chamber, whence the products of combustion are ejected through a nozzle at high velocity. The kinetic energy of the emergent gases entrains the surrounding gases in the tube, imparting energy to them sufficient to cause the whole mass to recirculate. The mass flow is thus greatly increased by contrast with the conventional method, and this gives rise to high heat transfer rates, the recirculation being in the order of 6 or 7. Also localised hot spots are completely eliminated.

Jetube furnace

The Jetube furnace is suitable for almost all commercial heat treatment operations. The furnace chamber is lined with the latest low thermal capacity insulating materials, thus giving unusually rapid recovery rates. Further economy is obtained by the use of special integral recuperators, in a furnace operating at 1,000°C. the temperature of the exhaust is reduced to 500°C.

Thermocouple materials

ACCURACIES of 1% below 400°C. and ¾% above 400°C. are obtained from the first of some new mineral insulated thermocouple materials available from Honeywell Controls Ltd.

Supplied separately or made up into thermocouples, the new material is suitable for use throughout industry, though not in the nuclear field. Initially there are two materials, chromel/alumel (Hoskins Company manufacture) and T1/T2, the wire sizes being .020 in. and .010 in. respectively, and overall sheath diameter .122 in. and .060 in.

Resistance per foot for the chromel/alumel is 1.1 ohms (positive conductor) and .44 ohms (negative); resistance per foot for the T1/T2 is 4.6 ohms (positive) and 1.85 ohms (negative). Insulation resistance is 100 megohms minimum. The material can be supplied with ends sealed and no junction made, alternatively as thermocouples having one hot junction, with or without mounting attachment. A thread is supplied as standard at the cold end.

The two materials are the first of several mineral insulated materials being introduced during 1960 by Honeywell Controls Ltd., Greenford, Middlesex.

New temperature controller

A NEW fully transistorised printed circuit amplifier-relay for use as a stable, sensitive, temperature controller, has also been introduced by Honeywell Controls Ltd.

With the appropriate thermistor temperature sensor, the R7079/7081 Versa-Tran can be used for control in the range of −60° to +500°F. with a differential of 1.5°F. or .3°F. depending on the model. Control is very stable and errors due to ambient temperature conditions are easily compensated for by a calibration dial.

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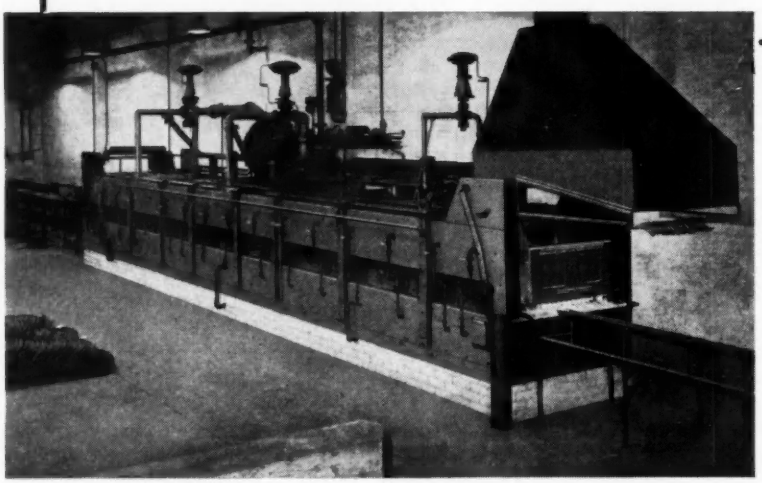

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